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ECONOMIC ANALYSIS OF INTERSTATE HIGHWAY ROUTINGS--VICINITY OF GLENDIVE

ECONOMIC ANALYSIS
OF
INTERSTATE HIGHWAY ROUTINGS

IN THE

VICINITY
OF
GLENDIVE

PREPARED BY

PLANNING SURVEY DIVISION
AND
INTERSTATE DIVISION
OF
MONTANA STATE HIGHWAY COMMISSION
IN COOPERATION WITH
U.S. DEPARTMENT OF COMMERCE
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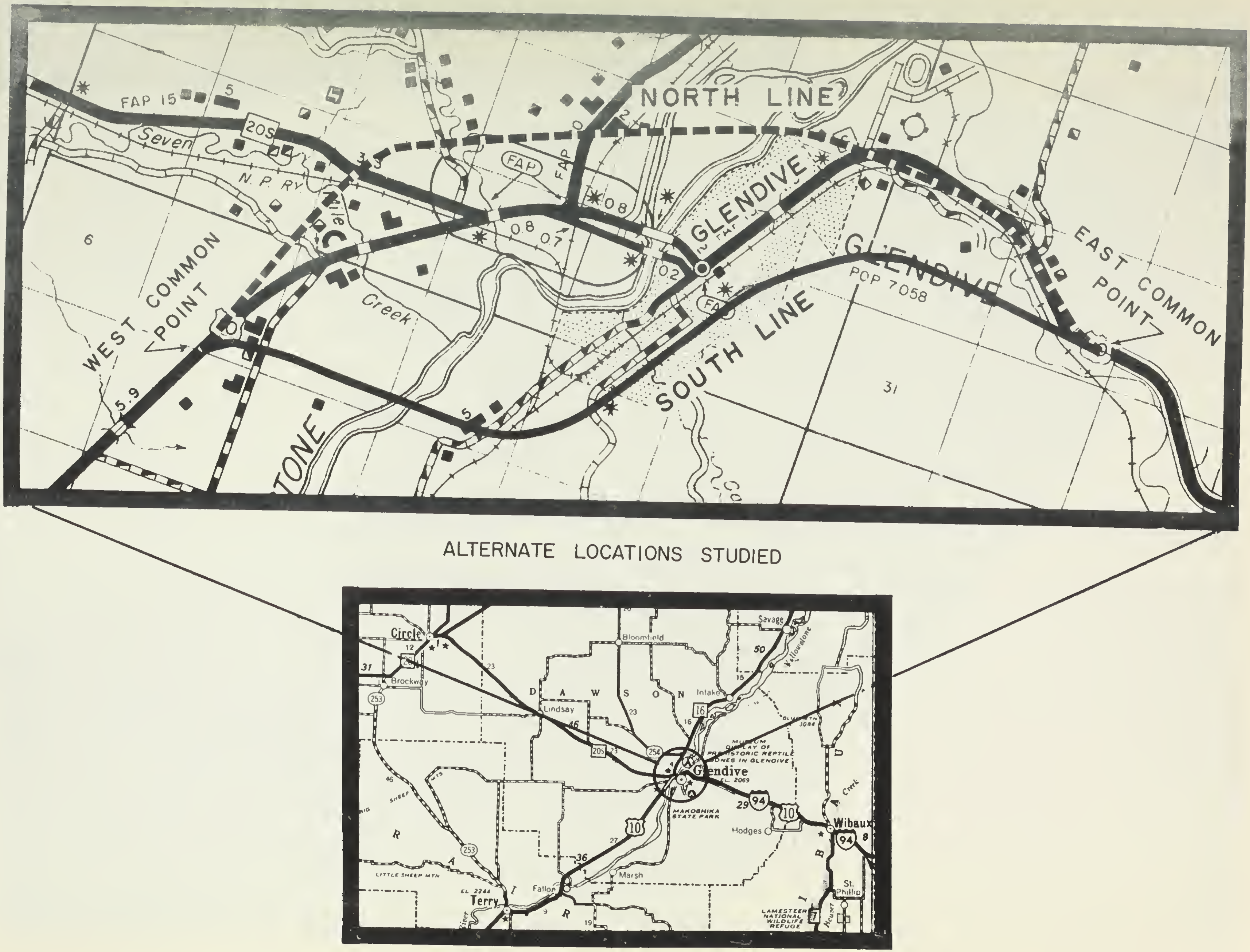
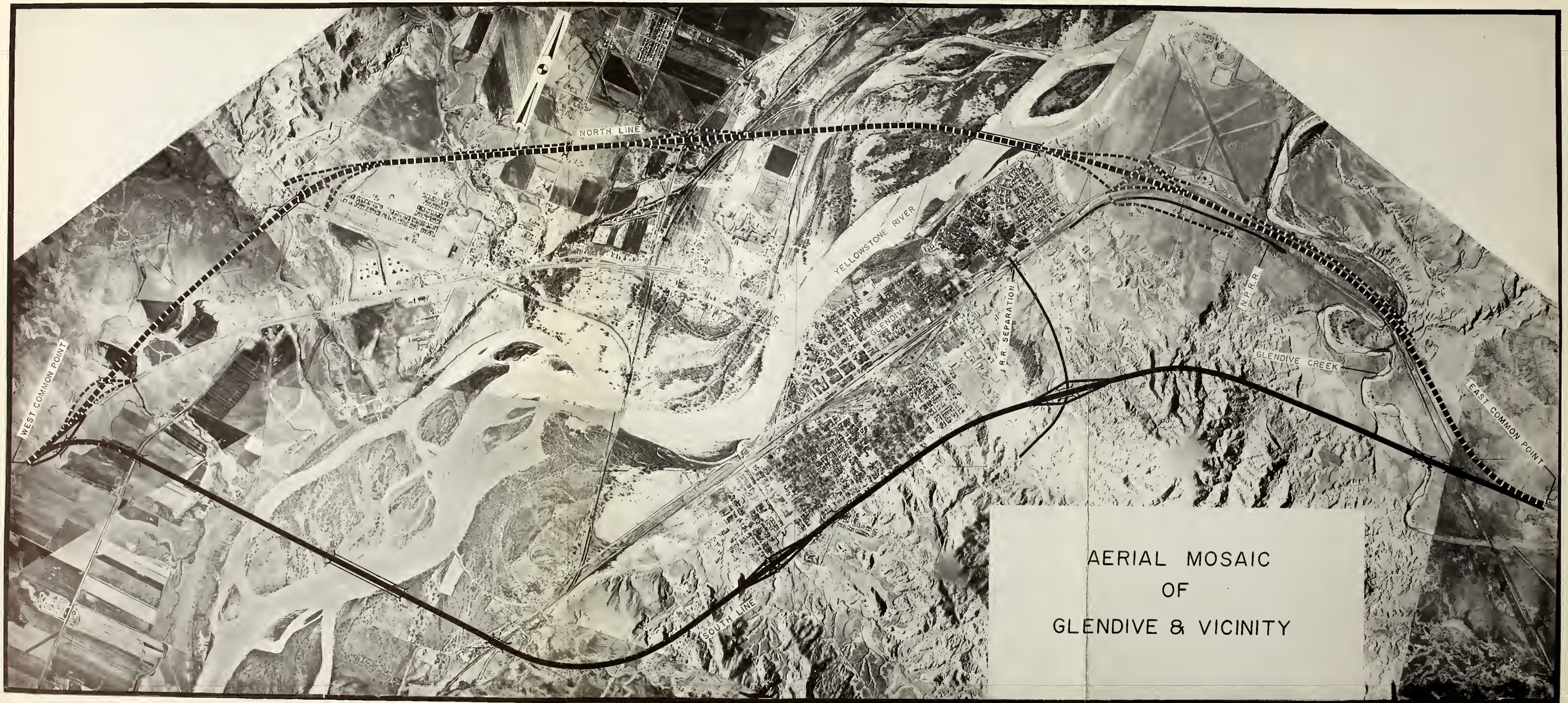


ALTERNATE LOCATIONS STUDIED



AERIAL MOSAIC
OF
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ECONOMIC ANALYSIS OF ALTERNATE LOCATIONS FOR INTERSTATE ROUTE 94 IN THE VICINITY OF GLENDIVE

March 8, 1963

FOREWORD

Over a period of years, several special traffic surveys and route location studies have been made in the vicinity of Glendive for the purpose of evaluating the merits of different locations for Interstate Route 94 in this vicinity.

In the summer of 1956, an origin-destination traffic survey was conducted at points on principal highways in the vicinity of the city. During this survey, vehicle drivers were stopped and questioned concerning their trip origins, routings, stopping points and destinations. The information obtained from this survey was used in evaluating the traffic service provided by alternate highway locations around the city. The results were also used in selecting the tentative location for Interstate Route 94 to the south of the city, as reported in the Section 108 (d) Study of July 1, 1957 which was required by the Federal Aid Highway Act of 1956.

The routings in the vicinity of Glendive were discussed at a public hearing which was held in Glendive on March 3, 1959. At this hearing, it was reported that the preliminary traffic data supported a location for Interstate Route 94 which passed to the southeast and south of the city as compared with locations to the northeast and north of the city. At the time of this hearing, a detailed investigation had not been made of construction costs for the alternate routes, so it was not possible to report on the overall rating of the different routes.

The majority of the local residents, who participated in this public hearing, also supported the location to the south of the city; however, it was their recommendation that the routing continue on the south side of the Yellowstone River to a point on the present highway near Fallon.

After reviewing the results of this hearing and the problems involved, it was decided that an economic analysis should be made of the feasible locations on both sides of the river from a point on U.S. 10 west of Fallon to a point on U.S. 10 east of Glendive. As part of the evaluation of traffic service for the rural section of highway between Glendive and Fallon, another origin-destination survey was conducted at a point on U.S. 10 west of Glendive during July of 1959.

The results of the economic analysis, which was published on November 9, 1959, favored the location for Interstate Route 94 which followed along the approximate line of the present highway on the north side of the river to a point near Glendive and then passed to the south and southeast of Glendive. This location was also reported in the Section 104 (b) 5 Study of August 1, 1960 which was submitted to the Bureau of Public Roads and to Congress.

Since local interests in the Glendive area continued to support a location for this route on the south side of the river, further investigations were made, at their request, of other locations in this area to determine if a line could be found which would improve the relative standing of a highway on the south side of the river. Although subsequent investigations improved the economic standing of the location on the south side of the river, the amount of improvement was not sufficient to overcome the advantages of the location on the north side of the river, and this routing remained the recommended location for Interstate Route 94 between Fallon and Glendive.

As previously mentioned, some preliminary investigations had been made of locations for Interstate Route 94 in the immediate area of Glendive to the north and northeast of the city; however, these investigations had not progressed to the point that lines and grades had been established or detailed construction cost estimates had been made. It was decided that the final location around the city could not be determined until a thorough investigation and comparison had been made of the features of the locations to the north of the city as well as to the south of the city. Such a comparison involves the evaluation of the construction costs for each route, the maintenance costs and the traffic service as reflected in vehicle operating costs.

In compliance with this decision, the Interstate Division recently conducted detailed investigations of feasible locations passing to the north and northeast of the city. The location to the south and southeast of the city was also re-evaluated which resulted in minor line changes and revised interchange locations and design. The route locations and other features are shown on the enclosed map and aerial photographs.

It was considered that the traffic data from the 1956 and 1959 origin-destination surveys had become somewhat obsolete. It was also evident that the changes in interchange locations and points of access to the city had reduced the value of the previous traffic analyses. For these reasons, it was decided that a new traffic survey should be made to provide the latest information and also to evaluate the traffic service more precisely on the basis of the latest interchange locations. As a result, a new origin-destination survey was conducted during the period of July 6 to 21, 1962. Interview stations were established at points at the edge of the city on Montana 20 leading to Circle, Montana 16 leading to Sidney, FAS Route 335 leading to Marsh, U.S. 10 East leading to Wibaux and U.S. 10 West leading to Fallon .

The results of this traffic survey are discussed under the section pertaining to traffic service.

ANALYSIS PROCEDURE

Persons having a major interest in new highway locations may be classified into four major categories as shown below:

1. Highway users -- persons driving on the highways contribute Federal and State highway-user taxes which provide almost the entire financial support for construction and maintenance of the highway facilities. In addition to the taxes paid for support of highways, the highway user also pays motor vehicle operating expenses for travel on the highways which amount to many times the amount paid in taxes. The highway location which has the lowest cost for construction and maintenance is not always the preferred location for the reason that such a location may involve additional travel distance or other adverse features which produce an increase in travel costs that more than offset any savings in construction and maintenance costs. For this reason, vehicle operating costs must be considered in combination with construction and maintenance costs in determining the highway location which would provide the best advantage to the highway user.

2. Property owners -- a new highway location involves the acquisition of new land for right-of-way. Although every effort is made to adequately compensate property owners for any land or other property required, there is an understandable reluctance for a person to relinquish his land or residence for highway purposes and move to another place in new surroundings. On the other hand, a new highway location may pass through deteriorated areas where the removal of dilapidated structures will improve the general appearance and welfare of the city or community. In most cases, the construction of a new highway will improve the value of adjacent land, particularly in the vicinity of interchanges.

3. Commercial interests -- a new highway location results in a change in the normal traffic patterns in the vicinity of and through a city or community. Many establishments such as motels, service stations and eating places are oriented to service for highway travelers, and the amount of business experienced is related substantially to the proximity to main highways and visibility from these highways. The change in traffic patterns resulting from a new highway may be expected to affect such establishments; however, experience has invariably shown that any loss to a particular establishment is more than offset by gains to the city as a whole.

4. Bureau of Public Roads -- about 91% of the money for the construction of the Interstate System is provided in the form of Federal aid which is obtained from Federal highway-user taxes and is distributed under the jurisdiction of the Bureau of Public Roads. Since this is a National System of Interstate and Defense Highways, certain standards must be met in constructing these highways, and the Bureau of Public Roads is charged with the responsibility for assuring that these standards are complied with and the Federal interests are recognized.

The final determination of the preferred highway location must give consideration to the interests of the four principal groups mentioned in the foregoing, and since there is generally a conflict of interests, it is necessary to develop a compromise location which will be of the greatest common benefit.

The principal objective of an analysis of this type is to appraise the alternate highway locations from the standpoint of the highway user. As previously mentioned, this involves an investigation of the construction costs, maintenance costs and motor vehicle operating costs for each route and an overall comparison of the results obtained by combining these individual costs.

To the extent possible, preliminary consideration is also given to the effect on property and commercial interests; however, these matters are more properly evaluated following the public hearing stage when local residents are given an opportunity to discuss the locations and to present their viewpoints on the matter.

DESCRIPTION OF ROUTES

As shown on a map and aerial photograph at the front of this report, two locations for Interstate Route 94 have been investigated in the vicinity of Glendive. For simplicity of reference, these are identified as the North Route and the South Route in relation to their general geographic location with respect to the city of Glendive.

North Route

The North Route begins at a point on present U.S. 10 about 1.1 miles southwest of the end of the recent four-lane construction in the West Glendive area. A directional interchange will be located in this vicinity to permit the movement of traffic between the Interstate highway and the present routing of U.S. 10 leading to the city. This interchange will serve inbound traffic moving to the northeast and outbound traffic moving to the southwest.

After leaving the interchange area, the North Route passes behind the cemetery area and crosses a local road which formerly served as the highway to Circle. It also crosses a local irrigation canal and continues to a point where a 650 foot structure crosses Seven Mile Creek, the Northern Pacific branch line to Circle and present Montana 20. This crossing will include ramps to provide interchange operations between Montana 20 and the Interstate highway. Full traffic movement will be provided by this interchange. This interchange will be located about one mile west of the present junction of U.S. 10 and Montana 20.

After passing this interchange area, the North Route continues in an easterly direction and passes to the north of the Forest Park subdivision. A local road near this point will be severed by the new highway, and traffic service will be restored by constructing a frontage road on the north side of the new highway to carry the diverted traffic to a separation structure which will be constructed over another local road near the Jefferson School.

The North Route then continues in an easterly direction to the point of intersection with Montana 16. An interchange at this point will provide full movement of traffic between the Interstate highway and Montana 16.

The North Route then continues beyond the interchange area and crosses the

Northern Pacific branch line to Sidney and passes to the north of the sewage lagoon. It then descends from the bench and crosses the Yellowstone River on a structure about 1,500 feet in length. The route then proceeds up a coulee near an abandoned golf course and intersects present U.S. 10 at a point near the airport. An interchange at this point serves all traffic movements between present U.S. 10 and the Interstate highway, and it provides access to the city of Glendive.

East of this interchange, difficulty occurs in locating the Interstate highway between the airport and the main line of the Northern Pacific Railway. The problem can be solved by either moving the railroad tracks or by modifying the airport facilities. This matter will be decided at a later date; however, the cost of moving about 6,000 feet of railroad track has been included as part of the construction cost estimates for this route.

A frontage road will be constructed on the south side of the railroad tracks to serve the area involved there. The new Interstate highway will overlay present U.S. 10 between the airport and the Belle Prairie road, so a new frontage road will be constructed between these points on the north side of the track to restore traffic service.

East of the Belle Prairie road, the North Route continues along present U.S. 10 to the east terminus at the point of connection with the recent Interstate construction in this area. There will be no interchange at this point, so traffic between Glendive and the Interstate highway will move through the interchange near the airport.

The length of the North Route is approximately 8.2 miles, being entirely of two-lane construction. In connection with this route, it will be necessary to construct about 2.2 miles of frontage road. Plans include four interchanges for this route and a major structure over the Yellowstone River. Other structures include a highway separation near the Jefferson School, a railroad separation over the N.P. Ry. line to Sidney and bridges over Glendive Creek east of Glendive.

South Route

The South Route follows the same general line as the location previously investigated and reported for this area, with the exception of interchange revisions.

The route begins at the same common terminus southwest of Glendive, as described for the North Route. At this point, the South Route leaves the present highway, and a directional interchange will be constructed to serve inbound traffic to the northeast and outbound traffic to the southwest.

Approximately one-half mile east of the interchange, the South Route passes over the local road that previously served as U.S. 10 in this vicinity. A highway separation structure will be constructed at this point to preserve the traffic movement on this road.

The South Route continues in an easterly direction and crosses the Yellowstone River on a structure about 1,800 feet long. This is not a favorable bridge site because of multiple channels and ice jams; however, it appears to

be the best location to fit the alignment of the Interstate highway in this area. One small channel of the river will probably be filled by the approach to the bridge, but a culvert will be installed to maintain the water level on the downstream side.

Approximately one-half mile east of the Yellowstone River, a railway separation structure will cross the main line of the Northern Pacific Railway. FAS Route 335 to Marsh will be relocated under the structure at this point so that continuity of this road may be maintained.

The South Route then changes to a northeasterly direction and passes along the southeast side of Glendive. An interchange is planned at the intersection with the road to Makoshika State Park. This will preserve the traffic movement to the park and the area south of the Interstate highway. This interchange will serve all traffic movements to and from the city.

The route then continues in a northeasterly direction along Rosser Avenue, with a highway separation being planned in the vicinity of Barry Street to preserve the service to the Dove Addition south of the highway.

The route then passes to the south of the city cemetery and continues to Graveyard Coulee where another interchange will be provided to serve the eastern part of the city. Since there will be no interchange to the east of this point, this interchange will serve as the principal connection between the city and the Interstate highway to the east of the city. As part of the traffic service, a new highway will be constructed through the Graveyard Coulee area to connect with present U.S. 10 (Merrill Avenue) in the vicinity of Gresham Street. This connection includes a proposal for a railroad separation structure in connection with the Northern Pacific tracks.

East of the Graveyard Coulee, the South Route passes through a rough, hilly area and then crosses Glendive Creek and the main line of the Northern Pacific Railway enroute to the eastern common terminus at the end of the recent Interstate construction east of Glendive.

The length of the South Route is 7.5 miles. In order to comply with the standards, it will be necessary to construct 1.9 miles of four-lane highway through the hilly area south and southeast of Glendive. The remaining 5.6 miles will be constructed as two-lane highway.

An additional 0.7 mile of new construction will be required through the Graveyard Coulee area to connect the Interstate highway with the eastern part of the city. No new frontage roads will be required on the South Route.

The South Route requires three interchanges, one highway separation over old U.S. 10 and another one over Barry Street, railroad separation structures over the Northern Pacific tracks west of Glendive and east of Glendive and over the same tracks for the Graveyard Coulee connection, a major bridge over the Yellowstone River and another bridge over Glendive Creek near the east terminus.

TRAFFIC SERVICE

Drivers of both passenger cars and trucks were stopped at the five interview stations described in the foreword and they were questioned concerning the origins of their trips, routings used, points stopped in the city and destinations after passing the interview station.

A total of 2,702 interviews was obtained during this period, with the distribution between stations as shown in the following table. This table also shows the type of vehicle involved and the classification of trips into the categories of those passing through the city without stopping, those passing through the city but stopping for some reason, and those starting or stopping in the city without the through passage features.

DISTRIBUTION AND CLASSIFICATION OF TRIPS

STATION AND TYPE OF TRIP	TYPE OF VEHICLE FOREIGN PASSENGER	MONTANA PASSENGER	TRUCKS	ALL VEHICLES
US 10 WEST				
Through- nonstop	163	74	27	264
Through with stop	197	35	21	253
Internal stop and start	62	233	45	340
TOTAL	422	342	93	857
MONT. 20				
Through - nonstop	65	19	16	100
Through with stop	90	16	12	118
Internal stop and start	47	142	54	243
TOTAL	202	177	82	461
MONT. 16				
Through - nonstop	54	39	22	115
Through with stop	33	39	12	84
Internal stop and start	15	209	25	249
TOTAL	102	287	59	448
US 10 EAST				
Through - nonstop	192	37	8	237
Through with stop	167	29	16	212
Internal stop and start	92	160	50	302
TOTAL	451	226	74	751
FAS 335				
Through - nonstop	1	8	2	11
Through with stops		2		2
Internal stop and start	19	127	26	172
TOTAL	20	137	28	185

The following table shows the combined data for all stations. It should be noted that out-of-state passenger cars are classified as foreign passenger cars in all tables.

DATA FOR COMBINED STATIONS

TYPE OF TRIP	FOREIGN PASSENGER	MONTANA PASSENGER	TRUCKS	ALL VEHICLES
Through - nonstop	475 - 40%	177 - 15%	75 - 22%	727 - 27%
Through with stop	487 - 41%	121 - 10%	61 - 18%	669 - 25%
Internal stop and start	235 - 19%	871 - 75%	200 - 60%	1306 - 48%
TOTAL	1197 -100%	1169 -100%	336 -100%	2702 -100%

From this table, it may be observed that there is considerable difference between the trip characteristics of Montana passenger cars and foreign passenger cars. Of the foreign passenger car drivers interviewed, 40% reported that their trips passed through the city without stopping. Forty-one percent of these drivers reported that they stopped in the city for some reason as part of the through trip and then continued their journey. The remaining 19% either started or terminated the day's trip in the city on the day of interview. Whereas 40% of the foreign passenger cars passed through the city without stopping, only 15% of the Montana passenger cars and 22% of the trucks passed through the city without stopping.

When all trips are taken into consideration, 27% passed through the city without stopping, 25% stopped for some reason and then continued the through trip, and 48% started or terminated in the city on the day of interview.

It may also be of interest to note that, of the foreign passenger cars interviewed, 19% stopped in the central business district and 38% stopped in other zones north of the railroad tracks, making a total of 57% of the trips stopping in the internal area north of the railroad tracks. About 3% of the foreign passenger cars stopped in zones south of the railroad tracks, and as reported above, the remaining 40% passed through the city without stopping.

It should be emphasized that the data reported to this point are representative of conditions existing at the time of the interviews. They are not representative, however, of year-around travel for the reason that the interviews were taken during the peak of the tourist season and during a year when there was an abnormal amount of travel to the Seattle World Fair.

In order to make a proper evaluation of traffic service on a year-around basis, these summertime interview figures were adjusted to a yearly average based on regular seasonal traffic counts taken during the year of 1961 in the vicinity of the interview stations. In effect, the proportion of foreign passenger cars, Montana passenger cars and trucks has been determined from the average of regular seasonal traffic counts taken during 1961, and the trip characteristics of these vehicles have been developed from the interview data of 1962.

The following table shows the proportion of the different types of vehicles

encountered during the limited and seasonal interview period and the proper proportion of these vehicles as developed from a yearly average of the regular traffic counts.

PROPORTION OF TYPES OF VEHICLES

TYPE OF VEHICLE	INTERVIEW PERIOD	REGULAR COUNTS
Foreign passenger car	44%	15%
Montana passenger car	43%	72%
Subtotal passenger cars	87%	87%
Trucks	13%	13%
TOTAL OF ALL VEHICLES	100%	100%

This table shows that, although the total number of passenger cars remains at 87% for both sources, there is a substantial difference in the percentage of Montana and foreign passenger cars under each source of data.

Since the trip characteristics of foreign passenger cars differ substantially from trip characteristics of Montana passenger cars and trucks, it is important that the proper adjustments be made to the interview data to obtain a more accurate record of the different types of trips based on the proper proportion of vehicles as obtained from the regular traffic counts. The following table presents a comparison of the trip classifications obtained from the interviews and the proper trip classifications as adjusted to conform to the proportions of vehicles obtained from the regular traffic counts.

TYPE OF TRIP MOVEMENT

TYPE OF TRIP	INTERVIEW PERIOD	REGULAR COUNTS
Through with stops	25%	17%
Internal stops and starts	48%	62%
Subtotal with stops and starts	73%	79%
Through - nonstop	27%	21%
TOTAL OF ALL TRIPS	100%	100%

The adjustments to conform to the proper proportion of vehicles obtained from the regular traffic counts result in a smaller proportion of through, nonstop trips and a higher proportion of trips with stops and starts in the internal area.

After the proper adjustments had been made to conform to the regular traffic counts, the trips were distributed as shown in the following table.

ADJUSTED DISTRIBUTION OF TRIPS

TYPE OF TRIP	PERCENTAGE OF TOTAL TRIPS PASSENGER CARS	TRUCKS	ALL VEHICLES
THROUGH TRIPS:			
Between US 10W and US 10E	6.21	0.65	6.86
Between US 10W and Mont. 16	4.98	0.79	5.77
Between US 10E and Mont. 20	3.14	0.14	3.28
Between US 10W and Mont. 20	1.70	0.46	2.16
Between US 10E and Mont. 16	1.30	0.29	1.59
Other through trips	1.14	0.34	1.48
Subtotal - Through Trips	18.47	2.67	21.14
INTERNAL TRIPS:			
To central business district	23.41	2.19	25.60
To other zones north of R.R.	33.80	6.37	40.17
Subtotal - North of R.R.	57.21	8.56	65.77
To zones south of R.R.	11.50	1.59	13.09
Subtotal - Internal Trips	68.71	10.15	78.86
TOTAL OF ALL TRIPS	87.18	12.82	100.00

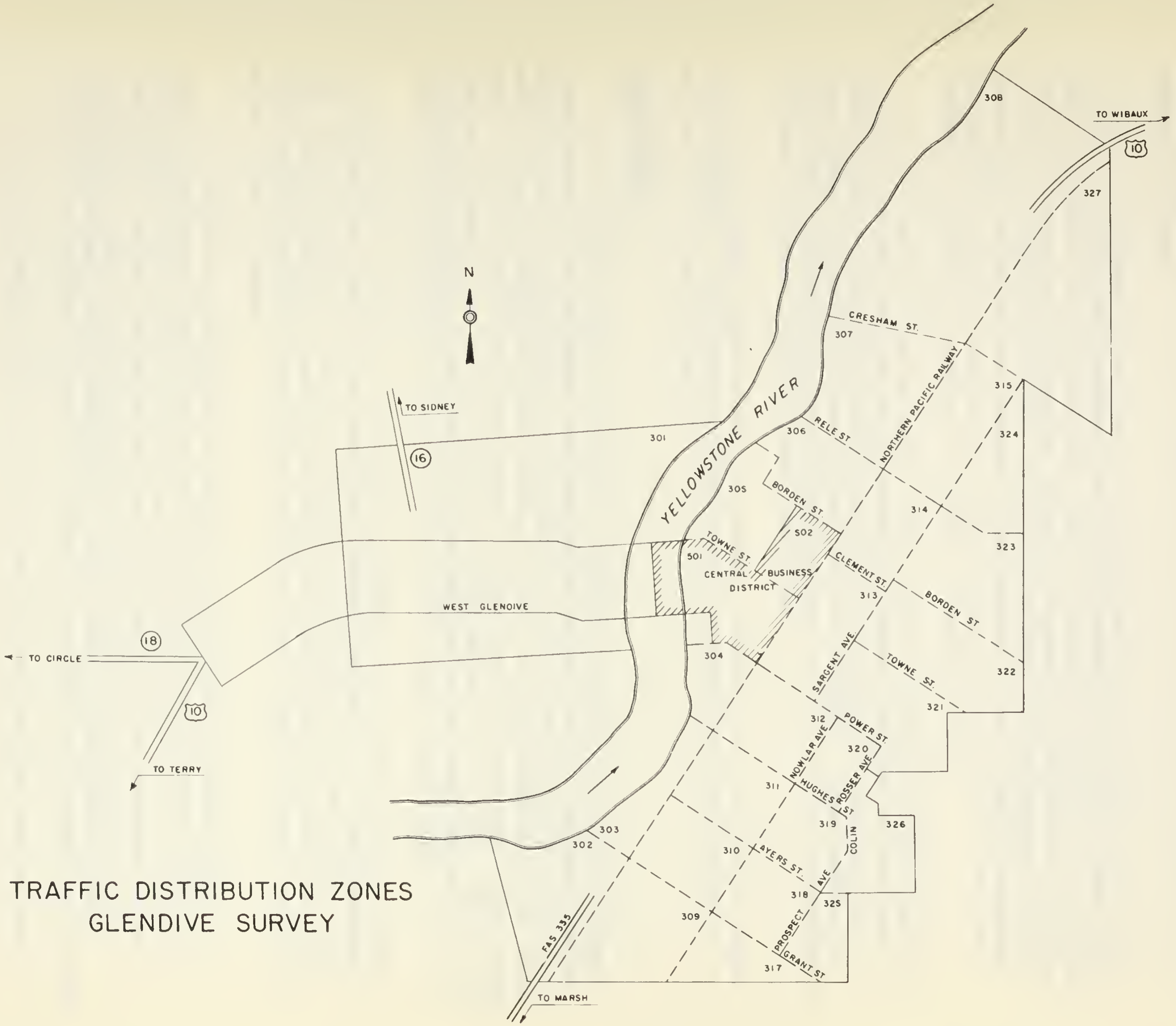
The traffic service provided by each of the alternate locations for Interstate Route 94 in the vicinity of Glendive has been evaluated by analyzing each trip reported at the interview stations to determine what effect each Interstate highway routing would have on that trip. Through, nonstop trips were grouped according to the number traveling between each external station and the other external stations. Trips with starts or stops in the internal area were classified according to the movements into and from zones which were established to consolidate the movements and to simplify the traffic analysis.

The railroad tracks through the city constitute a barrier dividing the city into areas northwest and southeast of the tracks. For simplicity, these are referred to as areas north of the tracks and south of the tracks. The area to the north of the tracks has been divided into ten zones, with two zones in the central business district and eight zones in the remainder of the north area. The area south of the tracks has been divided into 18 zones.

An analysis of the travel distances involved and the relative freedom of movement via the different highway facilities available leads to the following conclusions concerning the service provided by the alternate Interstate highway locations:

NORTH ROUTE

1. The North Route will provide shorter travel distances and less congestion than the present routings for all movements of through traffic, with the exception of traffic to and from FAS Route 335. Consequently, it may be



TRAFFIC DISTRIBUTION ZONES
GLENDIVE SURVEY

expected that such movements will use the North Route in preference to existing routings. Travel to and from FAS Route 335 will not benefit from use of the North Route, so it may be expected that this traffic will continue to use present routings.

2. The planned interchange at the intersection of the North Route and present US 10 East will preserve the present access to the city at that point. Traffic between the city and points east of the eastern terminus of the North Route will enjoy the advantage of using the higher-standard Interstate highway in place of present US 10 East. Also, trips between the northeastern sector of the city and US 10 West, Montana 20 and Montana 16 will find an advantage in traveling between these points via the North Route in place of the more congested routings via present facilities through the city.

3. A similar situation exists with regard to movements between Zone 301 northwest of the river and points beyond the eastern terminus of the North Route. Zone 301 comprises the area northwest of the river enclosing the development adjacent to the new highway in this vicinity. Trips between the points described will find an advantage in using the North Route and Montana 16 in place of present routings through the city.

4. All other trips between the external stations and the internal areas will continue to use present routings since the North Route will not be of any service to such movements.

SOUTH ROUTE

1. The South Route will provide a definite advantage for travel between zones south of the railroad track and points beyond the east and west termini of this route. Interchanges are planned at the intersection of the South Route and the road to Makoshika State Park and also at the intersection of the South Route and the road in Graveyard Coulee. A new road will be constructed in this coulee to connect the South Route with Merrill Avenue in the city. These interchanges and connecting roads will provide service to the area southeast of the railroad track which will be much improved over present conditions.

The travel distance to the zones southeast of the tracks will be substantially less for most of the zones than present routings. In a few instances the travel distance via the South Route to these zones will be slightly more than present routings; however, the ease and convenience of travel over Interstate facilities on the South Route will more than offset the minor amount of extra travel distance.

2. Since no interchange is planned at the eastern terminus where the South Route connects with the present highway, all travel between the city and points east of this connection must use the South Route for entrance to the city via either the Makoshika Road interchange or the Graveyard Coulee interchange. Most of this traffic will enter the city via the Graveyard Coulee interchange, and in doing so, it will benefit from shorter travel distances and improved highway facilities, as compared with present conditions.

3. The through traffic moving between the west terminus and the east

terminus will enjoy a substantial benefit as the result of shortened travel distance over the South Route and much better highway facilities as compared with the present routing through the city. A small amount of traffic between FAS Route 335 and the east terminus will experience minor benefit through usage of the South Route between the Makoshika Road interchange and the east terminus. The South Route will not serve any of the through traffic between US 10 West and Montana 20 or Montana 16. It also will not serve traffic between Montana 20 and Montana 16. Traffic between US 10 East and Montana 20 and Montana 16 will continue to follow present routings through the city; however, as mentioned in the foregoing paragraph, such traffic will benefit from usage of the South Route from the Graveyard Coulee interchange to the east terminus.

The total amount of travel involved under present conditions, under the North Route proposal and under the South Route proposal is compared in a table contained in the following section pertaining to vehicle operating costs. The results, as expressed in annual vehicle-miles of travel, have been computed by multiplying the number of trips involved between the external stations and between the external stations and interior zones by the travel distance involved via the different types of facilities.

VEHICLE OPERATING COSTS

After the traffic service has been evaluated and the amount of overall travel computed, the problem remains of converting the amount of travel involved to monetary terms by calculating the transportation costs involved under the alternate Interstate highway routings. This is achieved by multiplying the vehicle-miles of travel on each type of facility by the related passenger car and truck operating costs for that facility. The unit costs which were applied for this purpose are shown in the following table:

TYPE OF FACILITY	PASSENGER CARS	TRUCKS
INTERSTATE SYSTEM:		
2 lane	$.1022	$.2918
4 lane	.0980	.3230*
PRIMARY SYSTEM:		
2 lane	.1091	.3115
4 lane	.1010	.2848
CITY STREETS (AVERAGE)	.1405	.4012

* The cost of truck operation on the four-lane section is higher than two-lane operation because of steeper grades involved on the four-lane section. Steep grades have a greater effect on truck operating costs than on passenger car operating costs.

The following table presents a comparison of travel and vehicle operating cost data for present conditions, for the North Route and for the South Route of the Interstate highway locations. Under each of these conditions, the data show, for each type of highway facility involved, the annual number of trips, the average trip length, the annual vehicle miles of travel, the composite cost per vehicle mile for passenger cars and trucks, and the annual vehicle operating costs.

TYPE OF FACILITY	ANNUAL NO. OF TRIPS	AVERAGE TRIP LENGTH (miles)	ANNUAL VM OF TRAVEL	COST PER VM	ANNUAL OPERATING COSTS
PRESENT CONDITIONS:					
Primary highways:					
2 lane	1,181,140	2.201	2,599,689	$.1385	$360,057
4 lane	656,270	3.034	1,991,123	.1202	239,333
Subtotal	1,837,410	2.498	4,590,812	.1306	599,390
City streets	1,697,980	1.482	2,516,406	.1731	435,590
TOTAL	3,535,390	2.010	7,107,218	$.1456	$1,034,980
NORTH ROUTE:					
Primary highways:					
2 lane	932,210	1.129	1,052,465	$.1396	$146,924
4 lane	469,390	2.451	1,150,475	.1195	137,482
Subtotal	1,401,600	1.572	2,202,940	.1291	284,406
City streets	1,464,745	1.209	1,770,877	.1699	300,872
Interstate highways:					
2 lane	1,134,055	2.770	3,141,332	.1279	401,776
TOTAL	4,000,400	1.778	7,115,149	$.1387	$987,054
SOUTH ROUTE:					
Primary highways:					
2 lane	1,140,625	1.159	1,321,984	$.1371	$181,244
4 lane	464,280	2.953	1,371,019	.1225	167,950
Subtotal	1,604,905	1.678	2,693,003	.1297	349,194
City streets	1,628,630	1.245	2,027,644	.1751	355,040
Interstate highways:					
2 lane	616,850	2.261	1,394,698	.1228	171,269
4 lane	551,515	1.400	772,121	.1310	101,148
Subtotal	1,168,365	1.855	2,166,819	.1257	272,417
TOTAL	4,401,900	1.564	6,887,466	$.1418	$976,651

It may be noted that the number of annual trips in this table amounts to 3,535,390 for present conditions, 4,000,400 for the North Route and 4,401,900 for the South Route. The variation in the number of trips under each condition is accounted for by the fact that these are actually trip segments rather than complete trips. For example, a trip from the west terminus to the east terminus under present conditions would be classified as three separate segments consisting of one segment on 4-lane Primary highway, one segment on city streets and one segment on 2-lane Primary highway. The North Route and the South Route have more segments than present conditions for the reason that these routes also have 2-lane or 4-lane Interstate highways in addition to the facilities shown under present conditions.

In computing the vehicle operating costs, no consideration has been given to the extra cost of stops and slowdowns which are encountered at intersections and other congested areas. Such restrictions create a substantial amount of extra vehicle operating costs, especially for the heavier vehicles. An analysis of the operating costs involved for these restrictions results in the following figures:

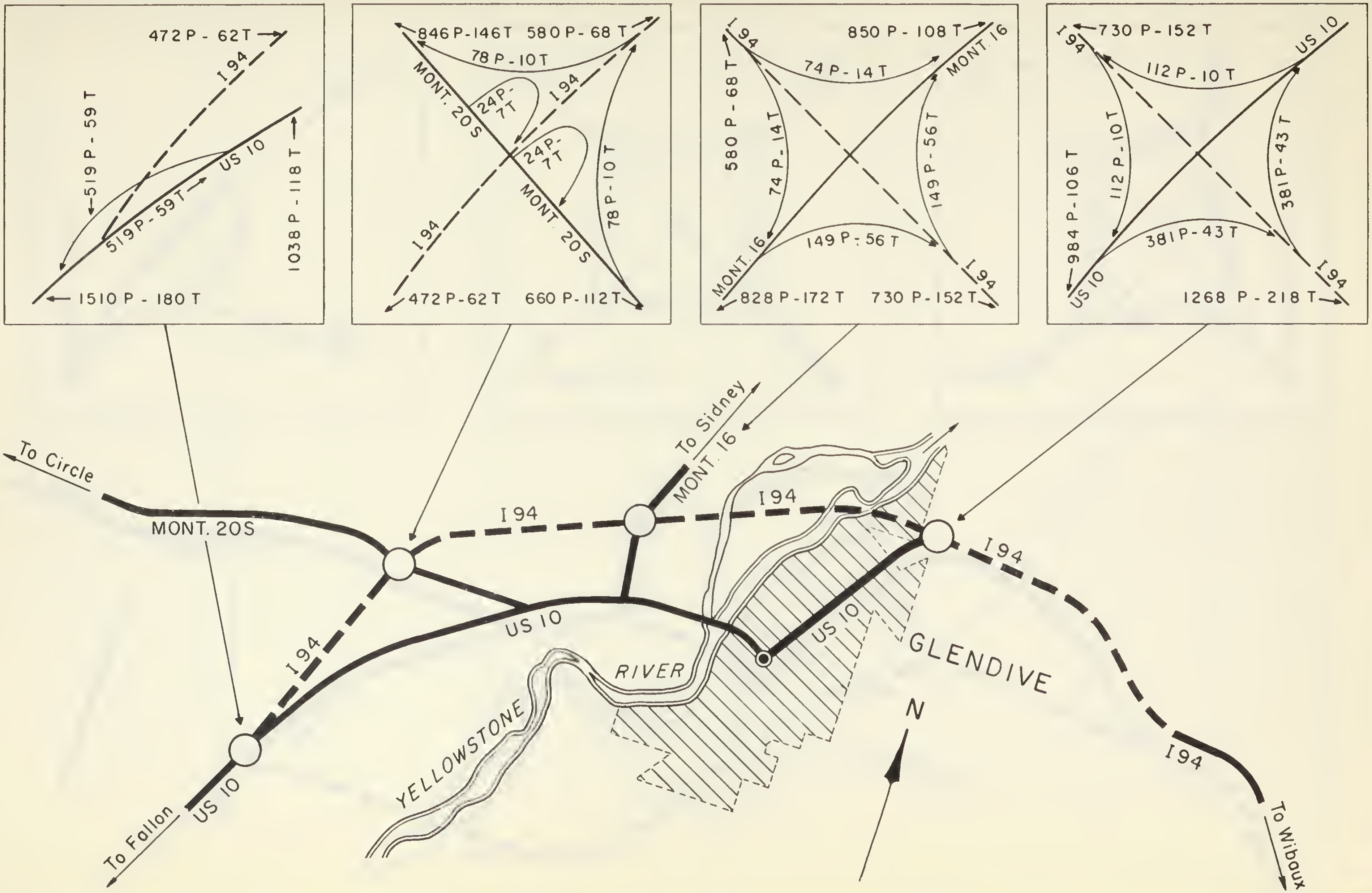
	ANNUAL OPERATING COSTS		
	PRESENT CONDITIONS	NORTH ROUTE	SOUTH ROUTE
STOPS AND SLOWDOWNS FOR -			
Passenger cars	$26,950	$21,417	$23,923
Trucks	14,782	11,015	13,514
All vehicles	$41,732	$32,432	$37,437

The following table summarizes the total of basic vehicle operating costs and the extra costs for stops and slowdowns.

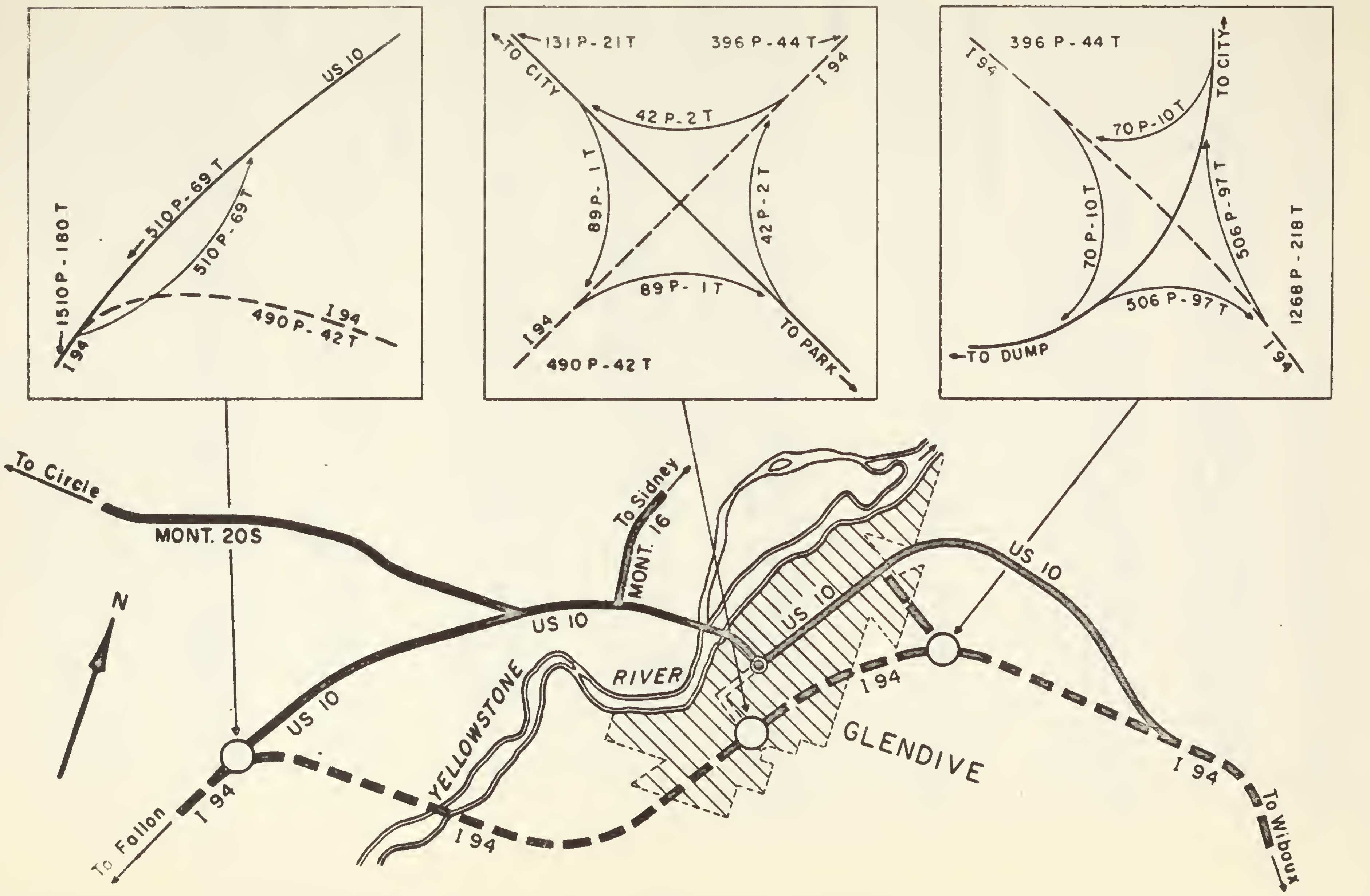
	ANNUAL OPERATING COSTS		
	PRESENT CONDITIONS	NORTH ROUTE	SOUTH ROUTE
Basic vehicle operating costs	$1,034,980	$987,054	$976,651
Cost of stops and slowdowns	41,732	32,432	37,437
TOTAL VEHICLE OPERATING COSTS	$1,076,712	$1,019,486	$1,014,088

This table shows that the South Route would be the most economical from the standpoint of overall vehicle operating costs. This route would save the highway user $5,398 per year, as compared with the North Route. It should be stressed, however, that this differential in favor of the South Route amounts to less than one-half of one percent of the total vehicle operating costs

TRAFFIC MOVEMENT DIAGRAM
FOR NORTH INTERSTATE ROUTE 94
(1961 TRAFFIC)



TRAFFIC MOVEMENT DIAGRAM
FOR SOUTH INTERSTATE ROUTE 94
(1961 TRAFFIC)



involved. Such a minor differential is inconclusive when it is considered that the traffic data are based on sampling processes and traffic assignment and vehicle operating costs are derived from estimates.

In view of these considerations, it must be assumed that the North Route and the South Route are about equal from the standpoint of motor vehicle operating costs, and the decision concerning the preferred route must rely on other factors.

The enclosed diagrams show the estimated distribution of 1961 traffic for each of the Interstate highway locations and the Interchange movements as developed during the traffic assignment process. The letters P and T on these diagrams identify passenger cars and trucks. Panel and Pickup trucks are included as passenger cars.

ESTIMATING PROCEDURE

The following is a description of the procedures followed in developing the estimated construction costs for each of the alternate Interstate highway locations.

Earthwork

Through the use of photogrammetry, contour maps were prepared for the entire North Route. The most favorable line was selected and the profile was established. Controlling grades were defined and earthwork quantities were computed from charts which relate height of fill and depth of cut and cross-section elements to earthwork volumes.

The same method of computing earthwork quantities was used for the South Route, with the exception that the profile was established from a field survey instead of photogrammetry.

Drainage

The cost of minor drainage pipes (less than 72" in diameter) was estimated on the basis of the average cost per mile. Where larger pipes were required, the cost was developed on the basis of individual requirements for each route.

Base and Surfacing

Base and surfacing costs were computed on a uniform basis for the two-lane and four-lane typical sections included in this report.

Structures

The costs for the bridges over the Yellowstone River on each route were prepared by the Bridge Division. Costs of other bridges and structures were computed on an area basis for the length and width involved.

Right-of-Way and Utilities

These estimates were prepared by the Right-of-Way division on the basis of field inspections.

Railroad Relocation

The cost of the contemplated relocation of the Northern Pacific Railway tracks on the North Route was estimated by engineers of the railway company.

CONSTRUCTION COSTS

The estimated construction costs for each Interstate route are summarized by principal categories in the enclosed Table No. 1. This table shows the estimated total costs for each route and the annual amortized costs based on the service lives shown, with interest on the capital investment at the rate of 6% per year.

This table shows that the North Route has an estimated total cost of $4,974,000 as compared with $6,162,600 for the South Route. The difference of $1,188,600 in favor of the North Route is largely attributable to lower costs for the North Route under the items of grading and drainage, other structures and right-of-way.

Although the North Route is about 0.7 mile longer than the South Route and has 2.2 miles of new frontage road, the overall costs for grading and drainage are lower than those of the South Route for the reason that the North Route is entirely of two-lane construction and passes through terrain that is relatively flat. The South Route has substantially higher grading and drainage costs through the area to the southeast of the city where the route passes through the rough, hilly terrain with major excavation problems. Through much of this area, it will be necessary to construct a four-lane highway to meet the required standards. This is also an area containing numerous drainage courses where extra drainage facilities must be provided.

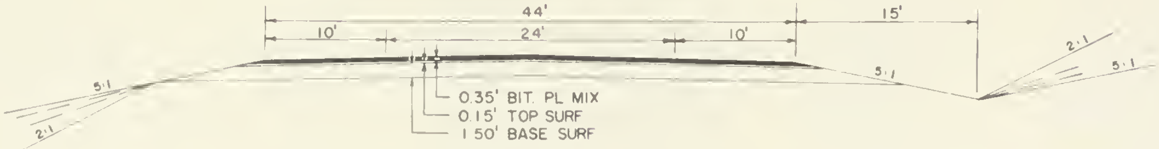
The cost of the grading and drainage for the 0.7 mile connection on the South Route through Graveyard Coulee also increases the cost of this category for the South Route.

The extra cost of other structures for the South Route is chargeable largely to the extra cost of the bridge over the Yellowstone River on this route. It is estimated that the cost of the Yellowstone River bridge on the North Route is $1,280,000 and $1,720,000 on the South Route. The length of the structure on the North Route is 1,500 feet and the length is 1,800 feet on the South Route. Heavier piers will also be required for the bridge on the South Route to offset the greater ice pressure at this site. Substantial riprap will also be required at this point.

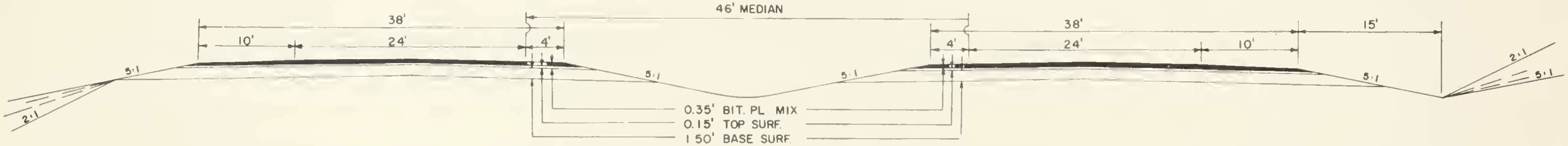
Structure costs for the South Route are also higher for the reason that the railroad separation west of Glendive must be lengthened to provide for the passage of FAS Route 335 at this point. The Graveyard Coulee interchange structure must be a dual facility to provide for the four-lane highway through this area.

TYPICAL SECTIONS

INTERSTATE



TWO LANE



FOUR LANE

TABLE NO. 1

ESTIMATED CONSTRUCTION COSTS

CONSTRUCTION CATEGORY	YEARS OF SERVICE LIFE	CAPITAL RECOVERY FACTOR	ESTIMATED CONSTRUCTION COSTS			
			NORTH ROUTE		SOUTH ROUTE	
			TOTAL COST	ANNUAL COST	TOTAL COST	ANNUAL COST
Utility adjustments	40	.0665	$ 115,000	$ 7,648	$ 83,000	$ 5,520
Grading and drainage	40	.0665	969,600	64,478	1,363,100	90,646
Base and surfacing	20	.0872	727,500	63,438	731,500	63,787
Interchange structures	50	.0634	187,400	11,881	237,400	15,051
Other structures	50	.0634	1,673,700	106,112	2,280,000	144,552
Traffic services	20	.0872	224,100	19,542	201,000	17,527
Railroad relocation	50	.0634	270,000	17,118	- - - -	- - - -
Subtotal - Construction			4,167,300	290,217	4,896,000	337,083
Right-of-way	50	.0634	190,000	12,046	542,000	34,362
Engineering & contingencies	40	.0665	616,700	41,010	724,600	48,186
TOTAL COSTS			$4,974,000	$ 343,273	$6,162,600	$ 419,631
SAVINGS IN FAVOR OF NORTH ROUTE			$1,188,600	$ 76,358		

Right-of-way acquisition costs will be substantially higher for the South Route because of the numerous houses involved along Rosser Avenue on this location. A field inspection discloses that about 56 house will be located within the proposed right-of-way limits on the South Route. The North Route will involve the removal of 5 houses and a small church.

It is evident, therefore, that the North Route would be the preferred location from the standpoint of construction problems and construction costs.

MAINTENANCE COSTS

The following table presents a comparison of the maintenance costs involved for the two Interstate routes and their related facilities.

TABLE NO. 2

ESTIMATED ANNUAL MAINTENANCE COSTS

TYPE OF HIGHWAY	MILES TO MAINTAIN	ANNUAL COST PER MILE	ANNUAL COST
NORTH ROUTE:			
Interstate 2-lane	8.2	$2,000	$ 16,400
Frontage roads	2.2	500	1,100
Interchange ramps	3.7	1,500	5,550
Present U.S. 10	6.7	1,500	10,050
TOTAL	20.8		$ 33,100
SOUTH ROUTE:			
Interstate 2-lane	5.6	2,000	11,200
Interstate 4-lane	1.9	3,000	5,700
Interchange ramps	2.5	1,500	3,750
Graveyard Coulee connection	0.7	1,500	1,050
Present U.S. 10	8.7	1,500	13,050
TOTAL	19.4		$ 34,750

The annual maintenance costs for the North Route would be $1,650 less than similar costs for the South Route.

SUMMARY OF ANNUAL COSTS

The following table presents a summary of the three basic costs which are of importance to the highway user in evaluating the alternate Interstate highway routings.

TABLE NO. 3

SUMMARY OF COMBINED ANNUAL COSTS

	NORTH ROUTE	SOUTH ROUTE
ANNUAL CONSTRUCTION COSTS	$ 343,273	$ 419,631
ANNUAL MAINTENANCE COSTS	33,100	34,750
SUBTOTAL	376,373	454,381
ANNUAL OPERATING COSTS	1,019,486	1,014,088
TOTAL ANNUAL COSTS	$1,395,859	$1,468,469
ANNUAL SAVINGS IN FAVOR OF NORTH ROUTE	$72,610	

CONCLUSIONS

The foregoing table shows that the North Route would be the preferred Interstate highway location from the standpoint of the highway user. This route would cost $72,610 less per year than the South Route in construction, maintenance and vehicle operating costs. This amounts to a differential of 5.2% in favor of the North Route.

As mentioned in the section of this report under ANALYSIS PROCEDURE, consideration should also be given to interests of persons other than the highway user in making a final decision concerning the approved highway location. A public hearing will be held at a later date for the purpose of enabling local interests to discuss these alternate routings and to present their viewpoints on the subject prior to the final decision stage. There are certain evident features, however, that extend beyond the highway-user analysis, and these features are reviewed briefly as part of this report.

It has previously been mentioned that right-of-way acquisition costs and damage to property are substantially greater on the South Route than they are on the North Route. Although the right-of-way acquisition process provides full compensation for the value of property required and related damages, there is also a certain amount of inconvenience and uncertainty involved for persons who must relinquish their property and find replacement facilities. This inconvenience cannot be evaluated in monetary terms;

however, it is evident that it would be much less on the North Route because there are only five dwellings required for right-of-way purposes on this route as compared with fifty-six dwellings on the South Route.

Another matter of considerable importance is the effect that the alternate routes would have on the future growth of the city. Because of its limited access features, an Interstate highway has a tendency to impose a barrier on freedom of movement between land on opposite sides of the highway. Since the South Route is located at the foot of a series of bluffs and rough terrain that already effectively restrict future growth in this area, a controlled access facility in the vicinity would not add materially to the hindrance of future growth.

The North Route passes through land that is farther removed from the present urban development; however, it traverses areas that appear to have a significant potential for future growth as evidenced by existing and planned subdivisions in the general area. It is evident that the North Route will impose some restrictions on unhampered growth of the area to the north of the city; however, the planned interchanges and highway separation in this area will minimize these restrictions. With respect to future commercial and industrial growth, the North Route should provide greater opportunities in these fields because of its proximity to existing sites and present highway facilities.

INTERCHANGE JUSTIFICATION

As a part of this report, an analysis has been made of the service provided by certain interchanges to determine whether or not the access privileges provided by the interchanges and reduced travel costs would exceed the cost of constructing and maintaining the necessary interchange facilities.

There is no doubt that the west interchanges for both the North Route and the South Route would be required for proper service to the city and the highway network in this area. The same situation applies to the Airport interchange on the North Route which will provide the principal point of ingress and egress between the city and the Interstate highway to the east of the city.

The Graveyard Coulee interchange on the South Route also serves as the principal point of access to the city for traffic moving between the city and the Interstate highway to the east of the city; however, the Makoshika Park road interchange also provides access to the same general area. This situation requires an analysis to determine whether or not full interchange facilities can be justified at both locations.

The economic justification for full interchange facilities is also not clear for the Circle highway (Montana 20) interchange and the Sidney highway (Montana 16) interchange on the North Route.

The analysis of economic justification for interchange facilities involves a comparison of the amount of savings that traffic would realize from the interchange facilities with the cost of constructing and maintaining the same interchange facilities. The enclosed Table No. 3 presents these comparisons for the interchanges under analysis, with separate treatment being given to the directional facilities.

TABLE NO. 3

INTERCHANGE JUSTIFICATION ANALYSIS

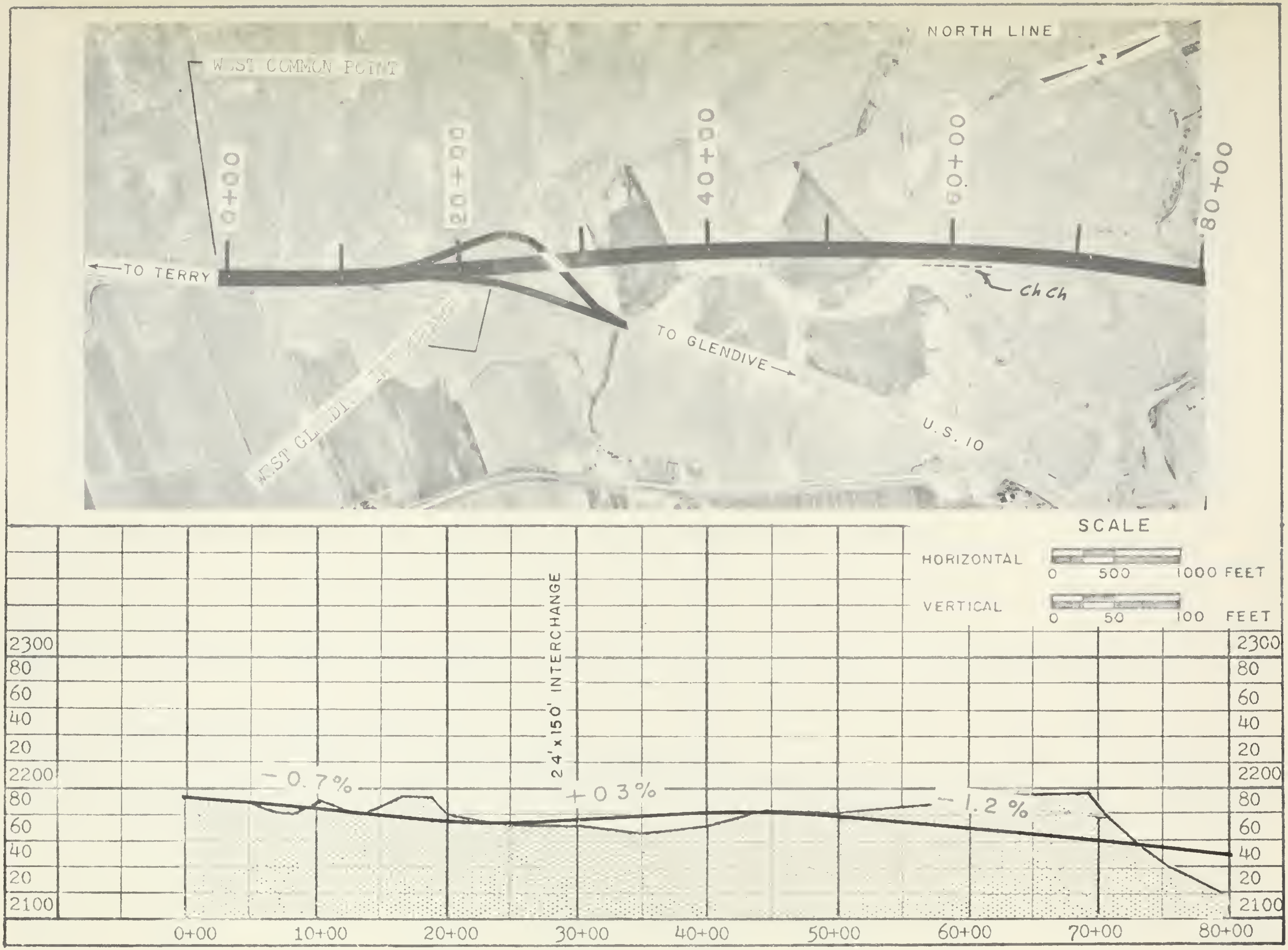
INTERCHANGE AND TRAFFIC MOVEMENT	ANNUAL OPERATING COST SAVINGS	ANNUAL COST OF			EXCESS OF SAVINGS OVER COSTS	RATIO OF COSTS TO SAVINGS
		CONSTRUCTION	MAINTENANCE	SUBTOTAL		
Circle Interchange:						
Westbound	$11,988	$4,142	$ 675	$4,817	$ 7,171	2.48
Eastbound	38,712	5,036	855	5,891	32,821	6.57
Combined	50,700	9,178	1,530	10,708	39,992	4.74
Sidney Interchange:						
Westbound	38,900	4,649	630	5,279	33,621	7.37
Eastbound	12,758	4,649	630	5,279	7,479	2.41
Combined	51,658	9,298	1,260	10,558	41,100	4.89
Makoshika Interchange:						
Westbound	19,888	5,460	630	6,090	13,798	3.26
Eastbound	15,025	5,016	630	5,646	9,379	2.66
Combined	34,913	10,476	1,260	11,736	23,177	2.97
Graveyard Interchange:						
Westbound	7,538	4,110	765	4,875	2,663	1.54
Eastbound	51,895	4,110	930	5,040	46,855	10.29
Combined	$59,433	$8,220	$1,695	$9,915	$49,518	5.99

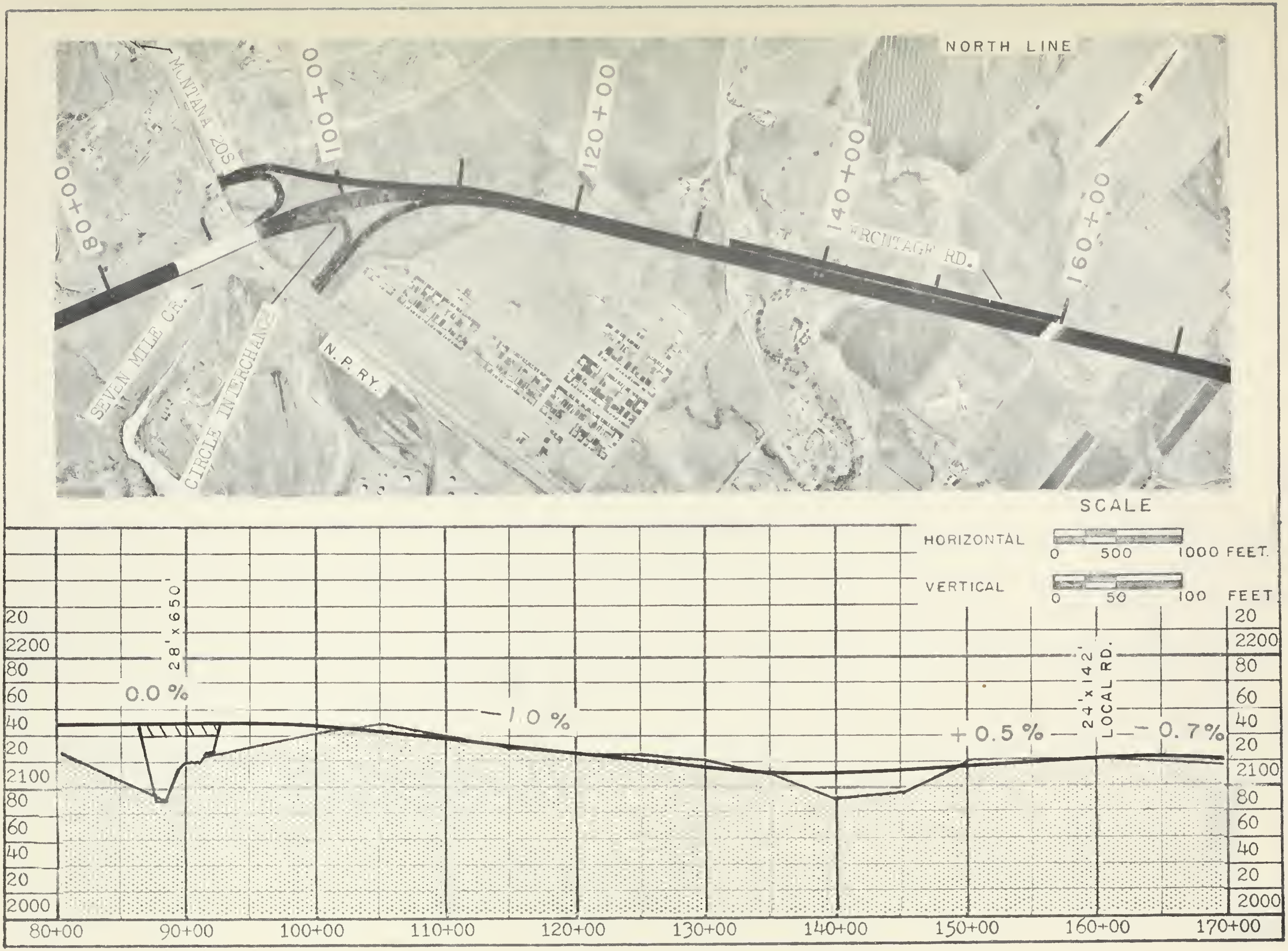
For all interchanges, except the Makoshika Park Road interchange, separation structures would be required even though interchange facilities were not provided. In these cases, therefore, only the costs of constructing and maintaining ramp facilities are chargeable against the savings to traffic.

In the case of the Makoshika Park Road interchange, the separation structure could be eliminated by routing cross traffic through the nearby separation at Barry Street. If this is done, it would be necessary to construct a 0.4 mile frontage road on the south side of the Interstate highway to preserve continuity of the road to the State Park. It is estimated that the cost of the separation structure would be $61,000 and the cost of the frontage road would be $41,000, leaving a net amount of $20,000 chargeable against the interchange. The elimination of the separation structure at the Makoshika Park Road interchange would also involve the cost of maintaining the frontage road and the cost of extra travel distance for the local traffic involved.

The figures in Table No. 3 show that the interchange facilities under analysis can be economically justified for the full interchanges or the individual directional facilities. The lowest value amounts to a ratio of 1.54 for the westbound facilities of the Graveyard Coulee interchange. In this case, the amount of savings to traffic would be 54% greater than the cost of constructing and maintaining the facilities. The highest value occurs in connection with the eastbound facilities for the same interchange. In this case, the savings to traffic would be approximately ten times the cost of constructing and maintaining the necessary facilities.

In deriving the annual construction cost figures in Table No. 3, the total costs of the facilities have been amortized over a period of years equal to the estimated service lives of the components, with interest being included at the rate of 6% per year. The savings to traffic have been computed for the average number of vehicles per year that are expected to use the facilities during the same period of service life. It is estimated that this traffic would amount to about 2.5 times the 1961 traffic.


NORTH LINE
WEST COMMON POINT
0+00
20+00
40+00
60+00
80+00
TO TERRY
TO GLENDIVE
U.S. 10
Ch Ch
SCALE
HORIZONTAL
0 500 1000 FEET
VERTICAL
0 50 100 FEET
24'x150' INTERCHANGE
– 0.7 %
+ 0 3 %
– 1.2 %
2300
80
60
40
20
2200
80
60
40
20
2100
0+00
10+00
20+00
30+00
40+00
50+00
60+00
70+00
80+00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MONTANA 20S
100+00
120+00
140+00
FRONTAGE RD.
160+00
SEVEN MILE CR.
CIRCLE INTERCHANG
N.P. RY.
SCALE
HORIZONTAL
0
500
1000 FEET
VERTICAL
0
50
100
FEET
28' x 650'
24' x 142'
LOCAL RD.
0.0 %
− 1.0 %
+ 0.5 %
− 0.7 %
20
2200
80
60
40
20
2100
80
60
40
20
2000
80+00
90+00
100+00
110+00
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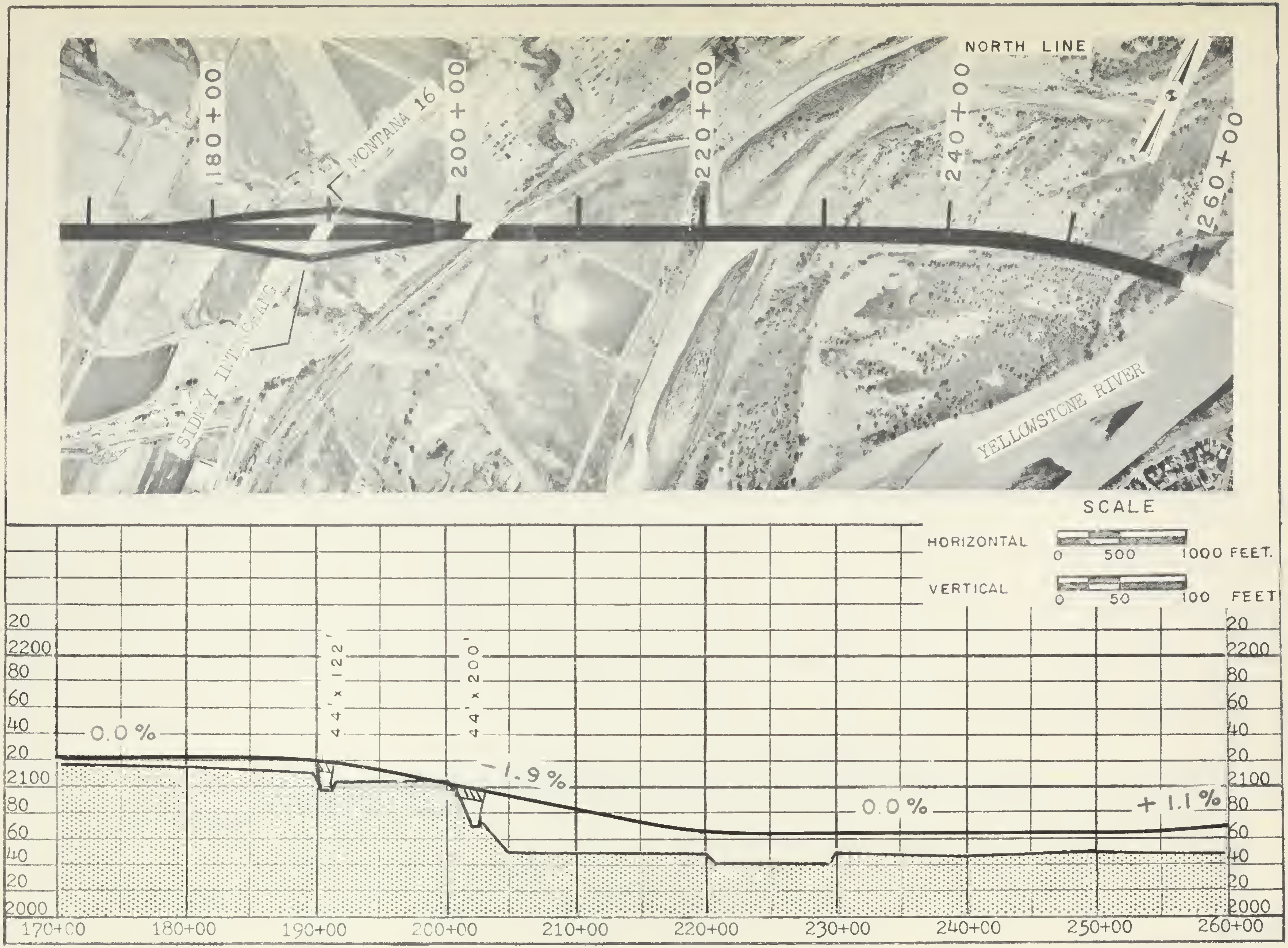
140+00
150+00
160+00
170+00


NORTH LINE
180+00
200+00
220+00
240+00
260+00
MONTANA 16
SIDNEY INT. CANAL
YELLOWSTONE RIVER
SCALE
HORIZONTAL 0 500 1000 FEET.
VERTICAL 0 50 100 FEET
0.0 %
44' x 122'
44' x 200'
-1.9 %
0.0 %
+1.1 %
2000
20
40
60
80
2100
20
40
60
80
2200
20
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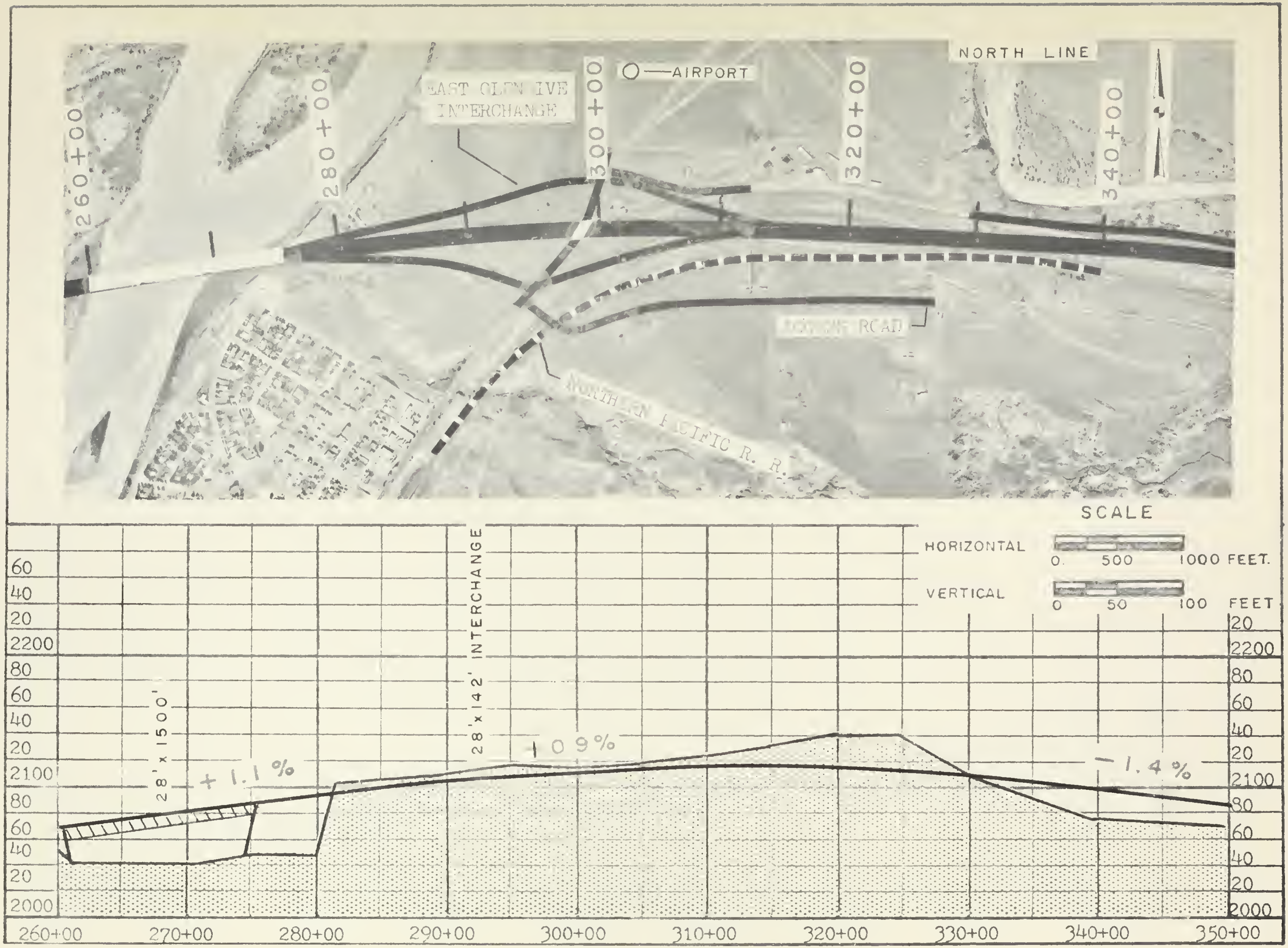
180+00
190+00
200+00
210+00
220+00
230+00
240+00
250+00
260+00


260+00
280+00
EAST GLENDIVE INTERCHANGE
300+00
AIRPORT
320+00
NORTH LINE
340+00
[illegible] ROAD
NORTHERN PACIFIC R. R.
SCALE
HORIZONTAL
0. 500 1000 FEET.
VERTICAL
0 50 100 FEET
28'x 1500'
28'x 142' INTERCHANGE
+ 1.1 %
+ 0.9 %
− 1.4 %
2000
20
40
60
80
2100
20
40
60
80
2200
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40
60
260+00
270+00
280+00
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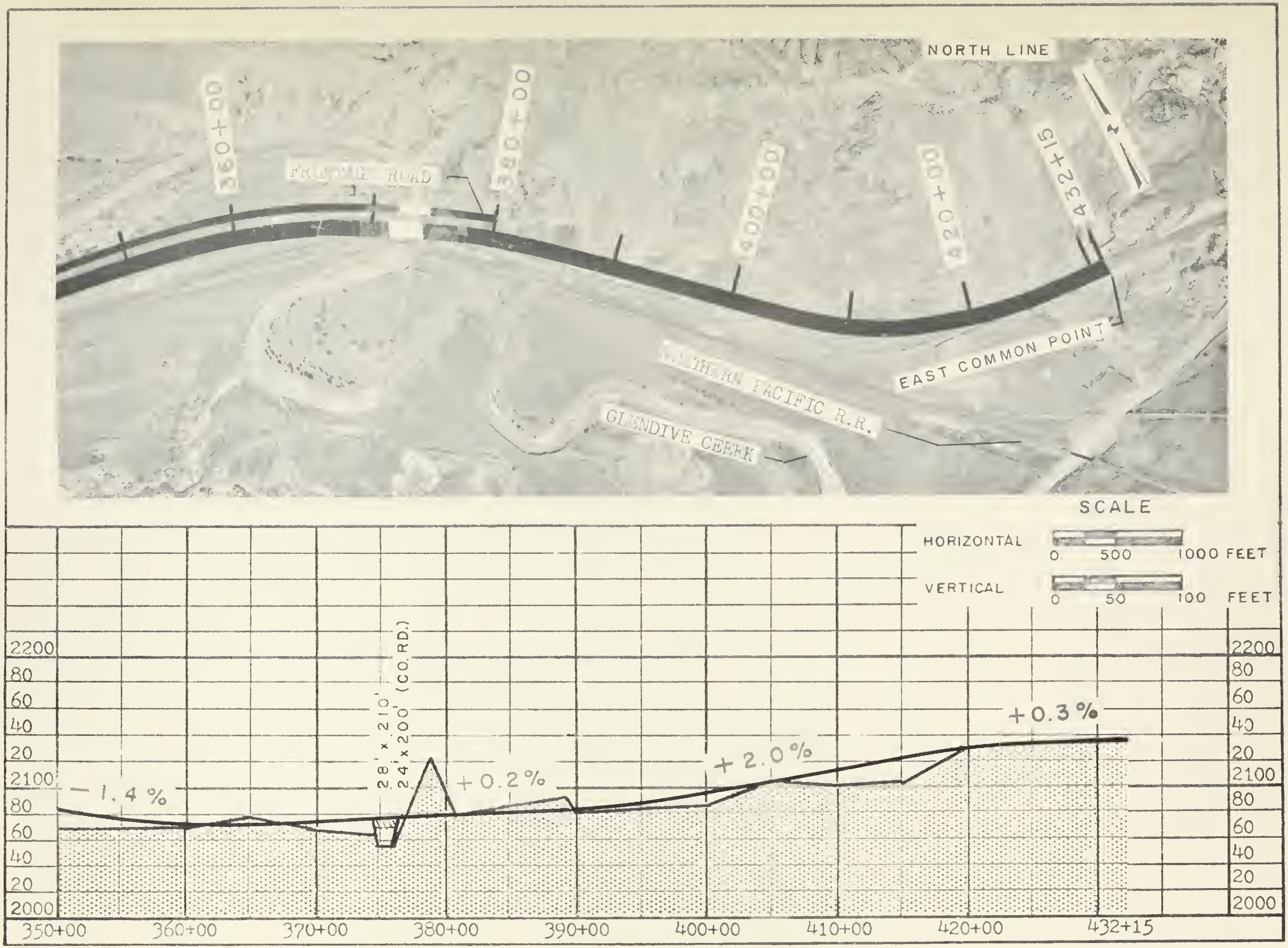
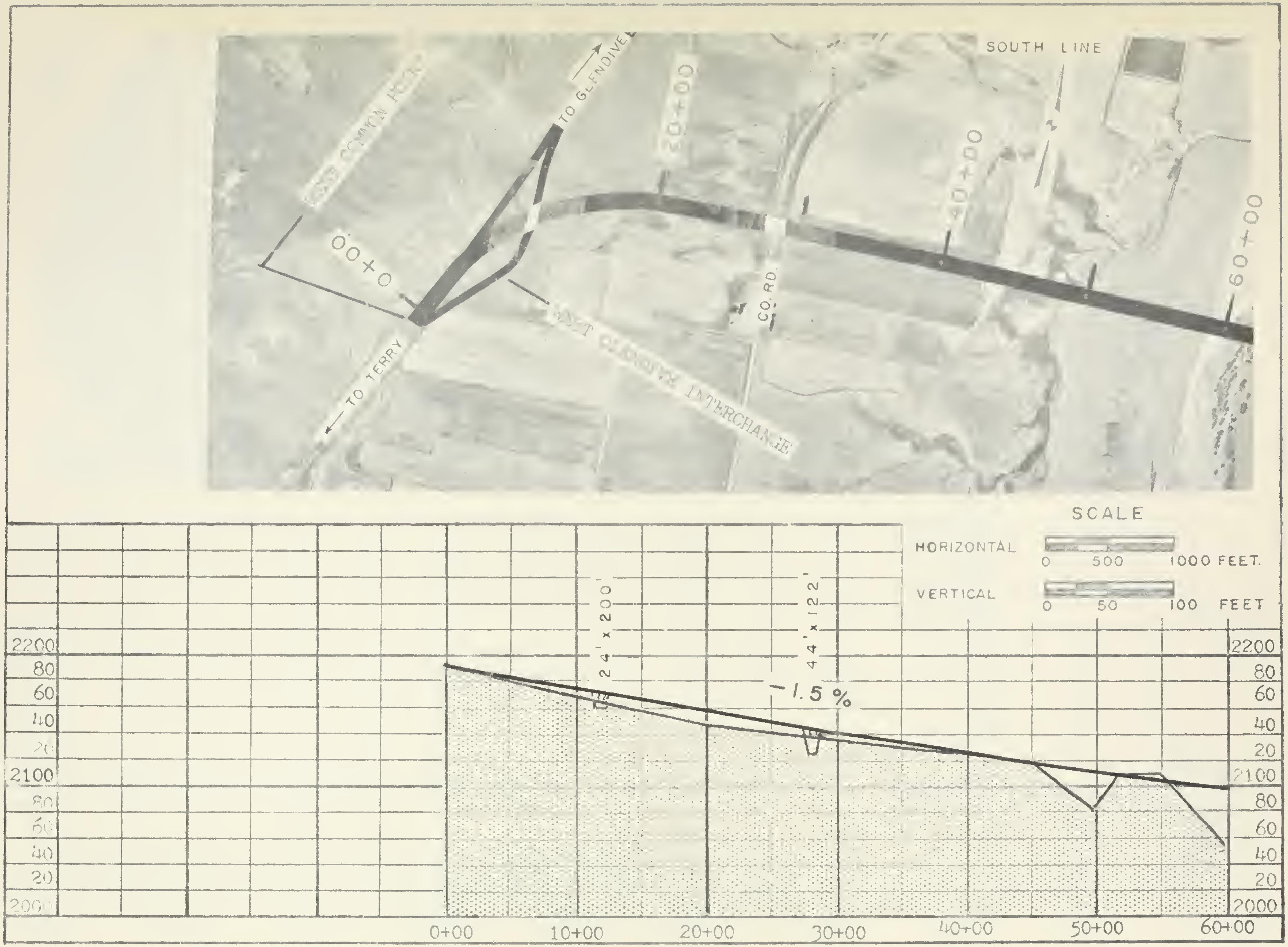
320+00
330+00
340+00
350+00


NORTH LINE
360+00
FRONTAGE ROAD
380+00
400+00
420+00
432+15
EAST COMMON POINT
NORTHERN PACIFIC R.R.
GLENDIVE CREEK
SCALE
HORIZONTAL
0
500
1000 FEET
VERTICAL
0
50
100
FEET
2200
80
60
40
20
2100
80
60
40
20
2000
− 1.4 %
28' x 210'
24' x 200' (CO. RD.)
+ 0.2 %
+ 2.0 %
+ 0.3 %
350+00
360+00
370+00
380+00
390+00
400+00
410+00
420+00
432+15


SOUTH LINE
TO GLENDIVE
TO TERRY
COMMON
INTERCHANGE
CO. RD.
0+00
20+00
40+00
60+00
SCALE
HORIZONTAL
0
500
1000 FEET.
VERTICAL
0
50
100 FEET
24' x 200'
44' x 122'
−1.5 %
2200
80
60
40
20
2100
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40
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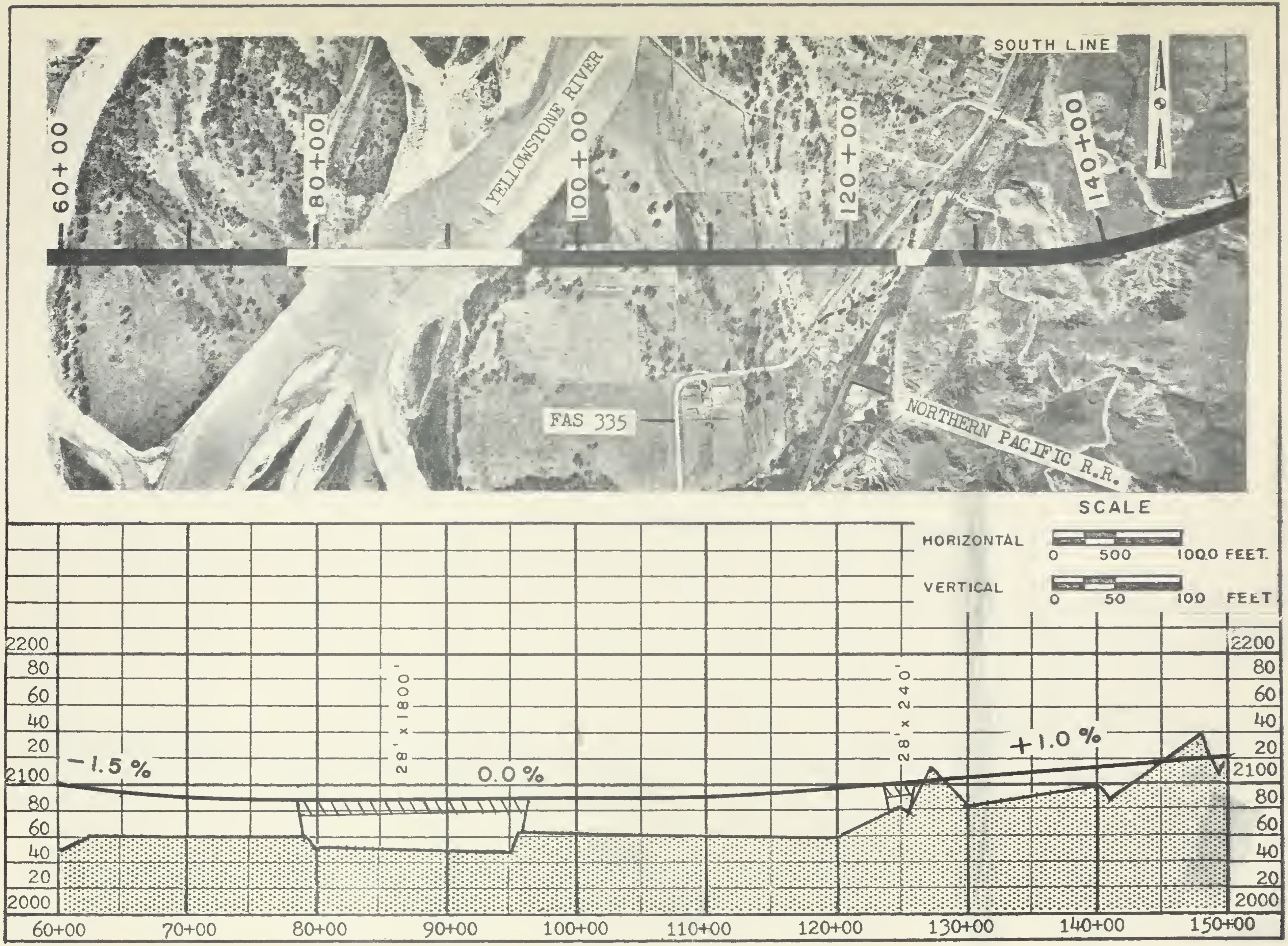
30+00
40+00
50+00
60+00


60+00
80+00
100+00
120+00
140+00
SOUTH LINE
YELLOWSTONE RIVER
FAS 335
NORTHERN PACIFIC R.R.
SCALE
HORIZONTAL
0 500 1000 FEET.
VERTICAL
0 50 100 FEET
28' x 1800'
28' x 240'
-1.5 %
0.0 %
+1.0 %
2200
80
60
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2100
80
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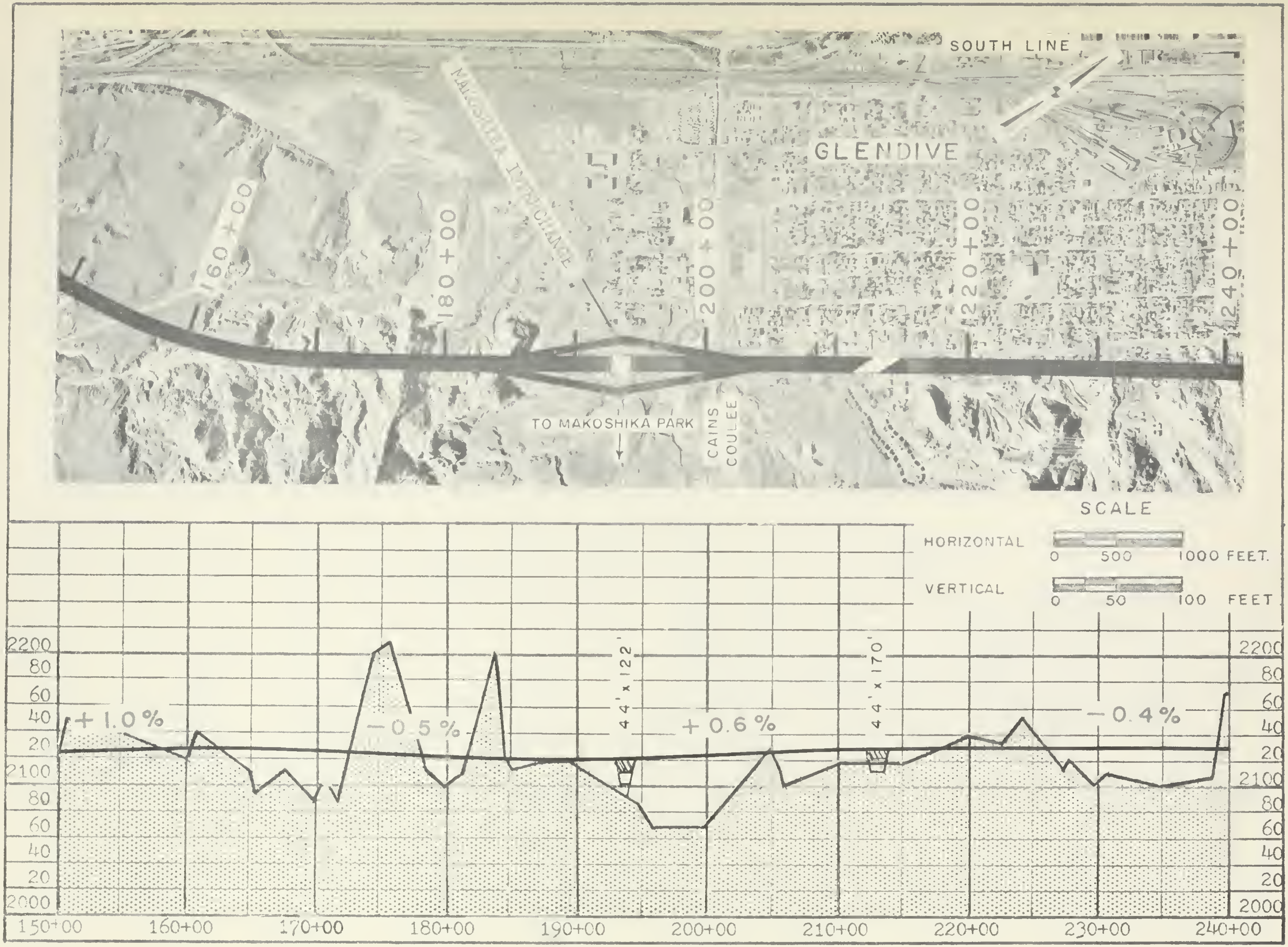
110+00
120+00
130+00
140+00
150+00


SOUTH LINE
GLENDIVE
MAKOSHIKA INTERCHANGE
TO MAKOSHIKA PARK
CAINS COULEE
160 + 00
180 + 00
200 + 00
220 + 00
240 + 00
SCALE
HORIZONTAL 0 500 1000 FEET.
VERTICAL 0 50 100 FEET
+ 1.0 %
− 0.5 %
+ 0.6 %
− 0.4 %
44' x 122'
44' x 170'
2200
80
60
40
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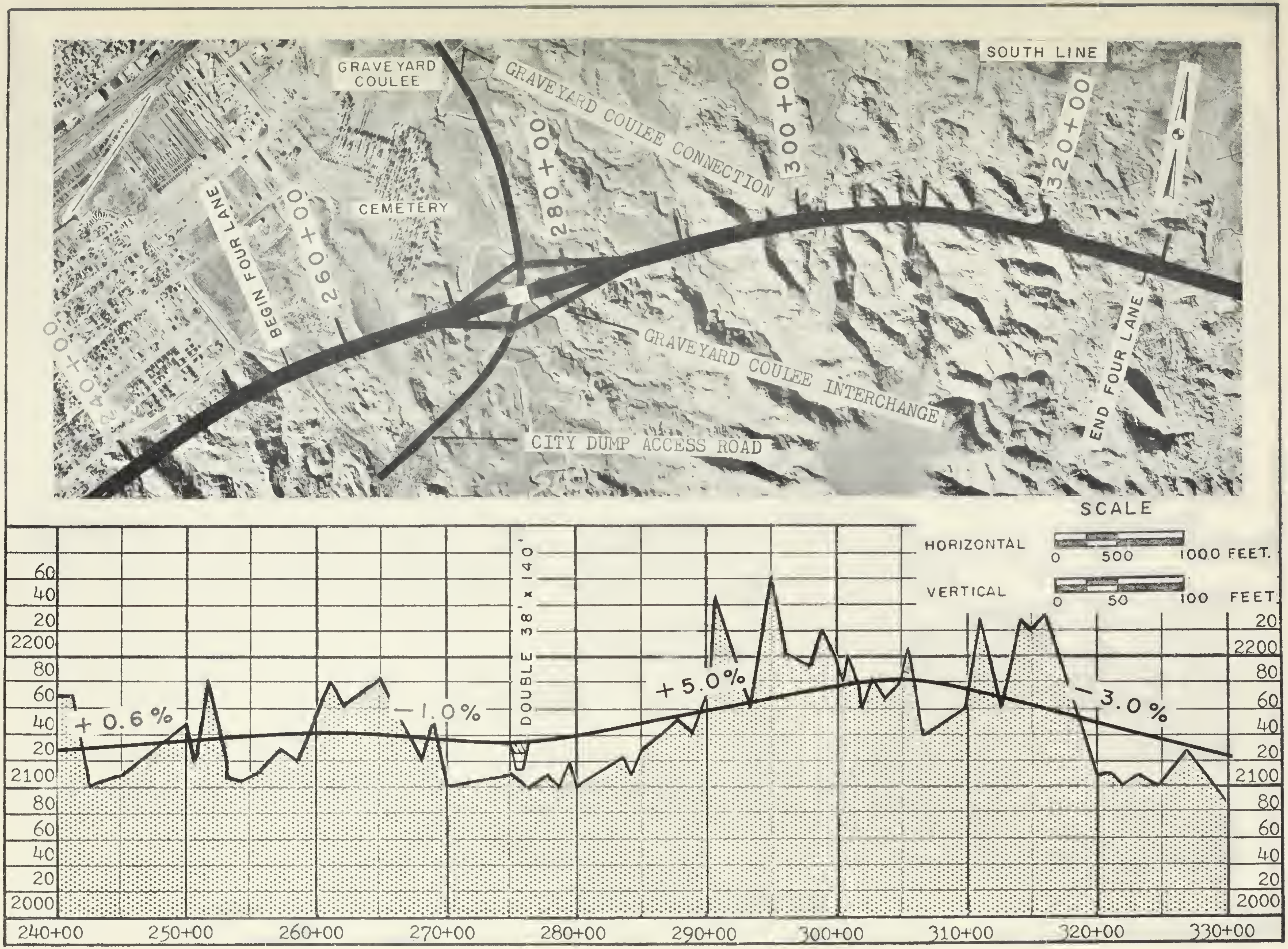
210+00
220+00
230+00
240+00


GRAVEYARD COULEE
SOUTH LINE
GRAVEYARD COULEE CONNECTION
300+00
320+00
280+00
260+00
240+00
BEGIN FOUR LANE
CEMETERY
GRAVEYARD COULEE INTERCHANGE
END FOUR LANE
CITY DUMP ACCESS ROAD
SCALE
HORIZONTAL
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500
1000 FEET.
VERTICAL
0
50
100
FEET.
DOUBLE 38' x 140'
+ 0.6 %
− 1.0 %
+ 5.0 %
− 3.0 %
60
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20
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2100
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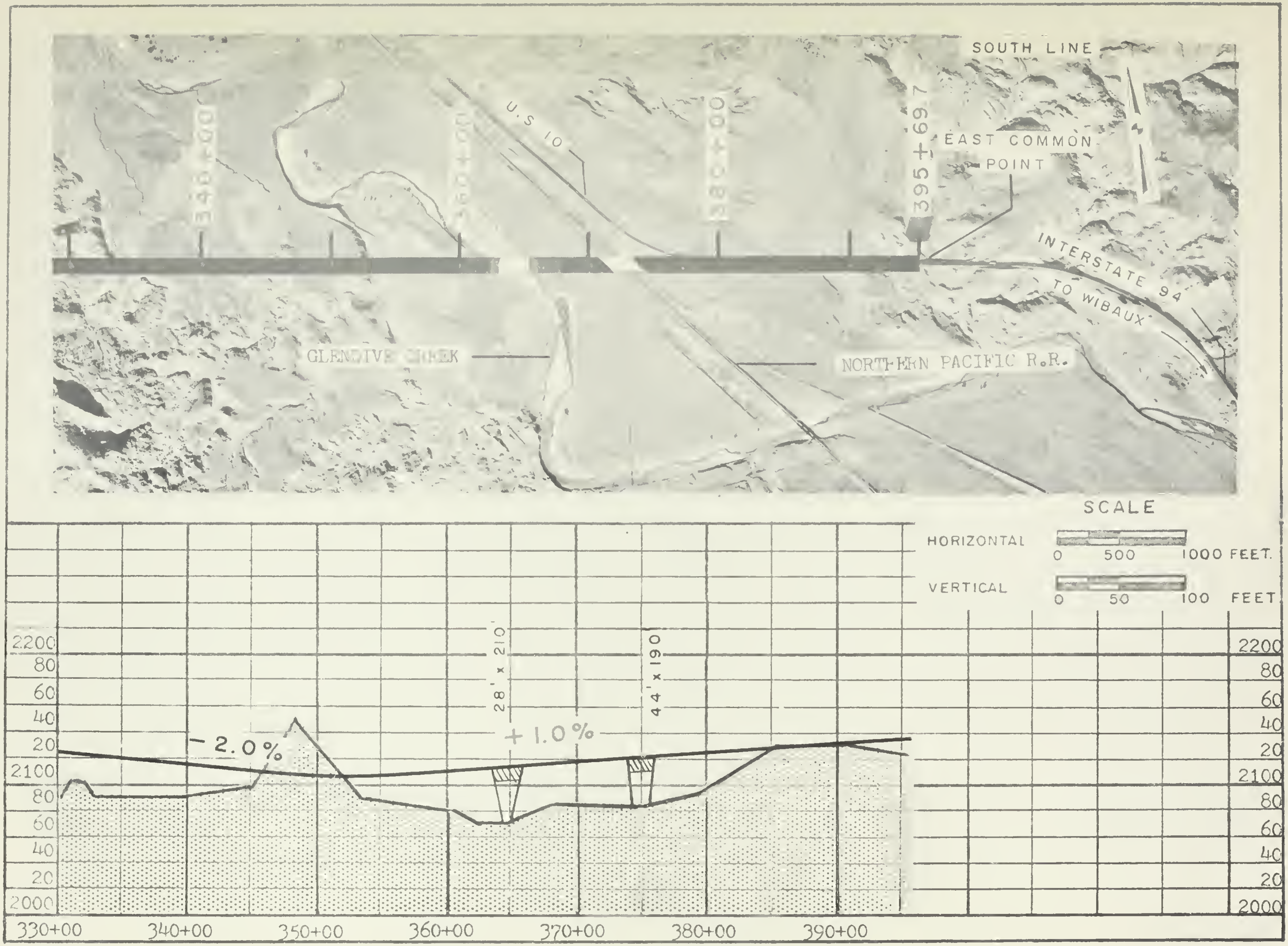
310+00
320+00
330+00


SOUTH LINE
EAST COMMON POINT
395+69.7
340+00
360+00
380+00
U.S. 10
INTERSTATE 94
TO WIBAUX
GLENDIVE CREEK
NORTHERN PACIFIC R.R.
SCALE
HORIZONTAL 0 500 1000 FEET.
VERTICAL 0 50 100 FEET
28' x 210'
44' x 190
−2.0%
+1.0%
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330+00
340+00
350+00
360+00
370+00
380+00
390+00